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at pleasure so long as the collimator is fixed. This is often a great convenience in working with the achromatic fringes; but I will pass these details over here.[2]

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[1] These PROCEEDINGS, 3, 1917, (563). In this note the glass paths, which are of less importance than the air paths, are too much accentuated.

[2] Abridged from a Report to the Carnegie Institution of Washington, D. C.

THE BRAIN WEIGHT IN RELATION TO THE BODY LENGTH AND ALSO THE PARTITION OF NON-PROTEIN NITROGEN, IN THE BRAIN OF THE GRAY SNAPPER (NEOMAENIS GRISEUS)

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Communicated by A. G. Mayer, December 24, 1917

The predatory fish called the gray snapper, *N. griseus* was mainly used for the present investigation, which was conducted at Tortugas, Florida in the summer of 1917. The following are the more important facts brought out.

1. The Brain Weight in Relation to Body Length.—Altogether observations have been made upon 74 brains of the gray snapper. It was found that the relation of brain weight to the increasing body length, from 150 mm. upward, is practically linear and may be satisfactorily expressed as $y = a + bx$, where y represents brain weight in grams and x the body length in millimeters, and a and b are the constants with the values, in this instance, -0.333 and 0.00433 respectively. (Body length is measured from the tip of the snout to the crotch of the tail.)

It is well known that in the adult stage the relation between brain weight and body length or body weight is practically linear, even in the case of some mammals[1] but it is remarkable to find the linear relation in fish, when they are so small. This linear relation during the period of early growth probably means that in the snapper the brain reaches its structural maturity early, and that the subsequent increase in weight indicates merely a uniform swelling of the nervous tissue as a whole.

On account of scantiness of the data for specimens less than 200 mm. in body length, I am unable to present a complete record of the growth of the brain. However, it appears from the general trend of the growth-curve that with the possible exception of the very early period, the relation between the brain weight and body length is linear.

Kellicott[2] studied the growth of the brain in the smooth dogfish in respect to the body weight, and found the graph to resemble that of the mammalian brain (logarithmic curve) and thus to differ strikingly from that for the gray snapper. This difference may be due to the fact that in the dogfish the brain possesses a voluminous cerebellum, as well as olfactory bulbs, and the combined weights of these two structures being greater than that of the rest of the brain, while these two structures in the gray snapper are very small. It appears that these two parts, olfactory bulbs and cerebellum of the dogfish brain, grow very rapidly during the earlier period, thus giving a form of the graph similar to that of the mammal.

2. *Percentage of Water in the Brain.*—Altogether 64 snappers were examined. It was found that so far as the present data are concerned, the percentage of water in the small and large fish is nearly identical within a wide range of body length, and therefore the percentage of water does not vary regularly with the length or size of the fish. Similar relations were observed by Donaldson[3] in the brain of the summer flounder and by Scott[4] in the brain of the smooth dogfish.

It is also interesting to note that the average percentages of water obtained by Donaldson, Scott and myself are nearly the same, being 78.4% (flounder), 78.5% (dogfish) and 78.61% (gray snapper) respectively. It is worthy of note that the values given by these fish are not much different from (slightly above) the percentage of water in the adult mammalian brain.

Since the reduction of the water in the brain is induced by the deposition of the 'myelin substance'[5] we may infer that the process of myelination in the fish brain occurs at a very early period, thus producing slight variation from small to large individuals, as here recorded. I have not however been able to determine the period of rapid reduction of the water content in the brain which must take place in this fish in consequence of the appearance of myelin, because of lack of very young material.

3. *Chemical Analysis of the Brain.*—Altogether 51 dried brains as well as 44 fresh brains were used for the purpose of the chemical analysis. With respect to the nitrogen in total solids, nitrogen in ether-alcohol extract, and the lipoid content, the fish brain closely resembles the stem of the rat brain, but significantly differs from the entire rat brain. This is explained by the fact that the fish brain corresponds essentially to the stem of the mammalian brain, owing to the small growth of the cerebrum and cerebellum. The content of non-protein nitrogen is considerably greater in the fish than in the rat brain. This phenomenon is interesting and I wish to call attention to two factors which may have some bearing on it.

It seems probable that on account of the low grade of organization of the fish brain, the physical consistence of the nervous system may not be as stable as that of more highly organized mammalian nervous systems, and thus the wear and tear process may be much greater, producing a correspondingly greater amount of waste products in the fish brain.

Again it has been found by several investigators that fish blood contains a greater abundance of non-protein nitrogen compared with human blood. The content of non-protein nitrogen in the rat blood is nearly identical with that in human blood.[6] It seems therefore conceivable that the high content of the non-protein nitrogen in the fish blood, accompanied by a slow circulation, might favor the deposition of waste products, and at the same time their slow removal would further tend to increase the accumulation.

[1] Donaldson, H. H., *J. Comp. Neur.*, *Wistar Inst.*, *Philadelphia*, **19**, 1909, (155–167).

[2] Kellicott, W. E., *Amer. J. Anat.*, *Wistar Inst.*, *Philadelphia*, **8**, 1908, (319–353).

[3] Donaldson, H. H., On the percentage of water in the brain of the summer flounder (*Paralichthys dentatus*) according to the body weight. MS. 1905.

[4] Scott, G. G., *Proc. Soc. Exp. Biol. Med.*, *New York*, **9**, 1912.

[5] Donaldson, H. H., *J. Comp. Neur.*, *Wistar Inst.*, *Philadelphia*, **26**, 1916, (443–451).

[6] Hatai, S., *Ibid.*, **28**, 1917, (361–378).

THE ROTATION AND RADIAL VELOCITY OF THE CENTRAL PART OF THE ANDROMEDA NEBULA

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Communicated by G. E. Hale, December 27, 1917

Indications of rotation in spiral nebulae are quickly obtained by means of spectrographs of very short focus and small dispersion, especially when a wide slit and devices for narrowing the spectrum are used. For definitive values of the rotation, however, it is necessary that the scale be relatively large, the slit narrow, and the exposures very long.

To investigate the rotation of the great nebula in Andromeda, which had been reported by V. M. Slipher at the nineteenth meeting of the American Astronomical Society, an exposure of seventy-nine hours was made during August, September, and October, 1917, with the focal-plane spectrograph of the 60-inch reflector. This instrument which is used at the primary focus of the large mirror has a collimator of 135 mm. focus, a 60° prism of ultra-violet glass, and for the camera a 154 mm. Cooke lens. The dispersion is such that 5.3 mm. corresponds to the interval from λ 4930 to λ 4950. The ratio of focal lengths of camera and collimator is 1.14, and the spectrograph therefore magnifies the image on the slit by this amount.

TABLE 1

DISTANCE FROM NUCLEUS		NUMBER OF SECTIONS	ADAMS	MISS BURWELL	MEAN
	seconds		*km.*	*km.*	*km.*
South Prec.	162	1	(−355)	(−469)	(−412)
	121	2	369	400	385
	66	2	342	342	342
	25	1	310	312	311
	0	1	307	317	312
North Foll.	41	2	288	308	298
	96	2	278	288	283
	137	1	(292)	(257)	(274)